CHAPTER X

SUMMARY AND RECOMMENDATIONS

A. SUMMARY OF RESULTS

The broad scope of the studies reported here requires a summary and an appraisal of results. Some of the results appear not to be in agreement with one another while the full consequences of other results appear not to fully impact the total picture. Some results tend to point to conclusions at variance with yet other conclusions. Hence, the following is as much a comparison and contrast and an appraisal as a summary.

The model resource chosen for the baseline preliminary conceptual design, costs, energetics, and economics studies is not an optimistic one. It is conservative in that it is fully justifiable on the basis of resource assessment results in hand. It represents perhaps the lower bound resource for electric generation while at the same time it is not a pessimistic view of the "identified" resource. It is unlikely that resources of lesser magnitude will be attractive for electric power generation because conversion process efficiencies are already low and because methane recovery will decline with declining temperature.

Effectively, three conversion system alternatives have been the object of preliminary concept analysis. Costs per kW installed capacity are high (from 20 to 40% higher than coal and nuclear generation facilities); overall capital costs, however, are controlled by the fuel production plants. On the other hand, the methane production derives sufficient income to offset large fuel plant capital costs and to provide low fuel costs to the electric generation plant. In general, the after-tax return on investment for both the fuel plant and power plant are low and not currently competitive with other investment opportunities.

The energetics analysis, in contrast, indicates that the geopressured geothermal resource competes successfully with nuclear and coal-fired power generation. This paradox probably arises from the fact that methane is underpriced with respect to electric power (on an equivalent basis). The approximately two-year energy recovery period presages that rapid escalation of energy and fuel costs will result in improving relative attractiveness for investment in geopressured geothermal power generation.

DISCLAIMER

The utilization of geopressured geothermal fluids for industrial application via fluids beneficiation (thermal upgrade) appears, after a first brief examination, to be both energetically and economically attractive. If further examination maintains the energetic and economic advantage, then the use of beneficiated goepressured geothermal fluids in Texas' and Louisiana's chemical, petroleum, and petrochemical industries may be more attractive economically than generation. Generation has the advantage over industrial utilization, however, in that it is more readily sited at the location of the geothermal reservoir than is much industry.

Any geothermal generation plant requires very significant heat rejection owing to low conversion efficiency. Careful design and cycle selection can mitigate or eliminate potential large potable water consumption. Industrial utilization of geothermal fluids can also reduce potential potable water consumption.

Effluent geothermal fluids represent a very significant problem which demands detailed study during site selection for drilling exploration wells for production testing. More importantly, full commercialization of a reservoir of the size envisioned in the model resource will produce vast quantities of effluent. Although adequate cost considerations have been given for subsurface disposal, the surface alternative has thus far received no study. This omission needs to be corrected with dispatch.

Technically, no insurmountable problems have been identified. Important issues identified as deserving of study are: low-enthalpy steam turbine service performance, heat exchanger service life and performance, geohydraulic turbine service testing, binary mixture secondary working fluid technology, integral secondary fluid condenser/dry cooling tower design and service evaluation, and water/methane separator technology. A sequence of studies, test programs, and test facilities is outlined to accompany and follow up successful production testing of an exploration well.

In summary, although current economics for geopressured geothermal power generation appear less favorable than for competing investment, the net energetics results indicate that the marginal economic position most probably will improve with escalation of fuel and energy prices. As the technology is relatively mature and can be implemented in the near term

and as a moderate resource base is beginning to be identified, the investment in a test well or test wells to help establish the productivity and characteristics of the resource is justifiable. However, steps beyond test wells must be both carefully and systematically executed if commercialization within 10 - 12 years can obtain in a cost-effective manner.

B. FUTURE RECOMMENDATIONS

Table VII, Volume I, outlines the estimated annual costs and total costs for a six-year program culminating in a pilot generation plant by 1981. Figure 3, Volume I, presents the time schedule corresponding to the funding program. It must be emphasized that the time schedule is very tight and allows for little vacillation in decision-making and almost no unexpected results. A more pessimistic time schedule, allowing for unexpected technical problems and procurement delays, could stretch out to 1983 or 1984. Corresponding escalations in cost could be expected if schedule stretch-out occurs.

A serious problem as yet not addressed is the form of industry financial and management participation in the expensive middle and later parts of the six-year schedule. Such participation needs to be formalized prior to proceeding with the major test facility and/or the pilot plant. Previous experience shows that periods of two or more years are required to negotiate similar cooperative arrangements. Types of arrangements one could visualize are:

(1) A contribution supported research association or foundation to provide matching funds for federal funds and a focus for program management and operations.

(2) A private, non-profit corporation specifically set up to provide a program management and facility operations structure; financial support could come from purchase of shares or from contributions. This option provides the framework for an organization to negotiate for capital loans under the Geothermal Loan Guarantee Program.

The important point to note now is that, should more than two years be required to arrange an industrial participation program, the research and development program could be correspondingly delayed.